THE CLOUD CHAMBER

Purpose:

The Cloud Chamber experiment illustrates that though radiation cannot be detected with the senses, it is possible to observe the result of radioactive decay.

Concepts:

1. Radiation cannot be detected directly by using our senses.

Duration of Lesson:

One 50-minute class period.

Objectives:

As a result of participation in the Cloud Chamber experiment, the learner will be able to:

1. describe that as charged particles pass through the chamber, they leave an observable track much like the vapor trail of a jet plane; and
2. conclude that what he/she has observed is the result of radioactive decay.

Optional Objectives:

1. Through measurement of tracks in the Cloud Chamber, the learner will be able to determine which type of radiation travels farthest from its source.
2. By holding a strong magnet next to the Cloud Chamber, the learner will be able to deduce what effect, if any, a magnet has on radiation.
3. By wrapping the source alternately in paper, aluminum foil, plastic wrap and then cloth, the learner will be able to conclude what effect, if any, shielding has on radiation.

Skills:

Drawing conclusions, measuring, note-taking, observing, deductive reasoning, working in groups

Vocabulary:

Alpha particle, beta particle, gamma ray

Materials:

Activity Sheets

The Cloud Chamber, p. 87

Background Notes

Safe Use of Dry Ice, p. 5

Cloud Chamber, p. 5

Suggested Procedure:

1. It is suggested that students work in groups no larger than three or four in order to derive maximum benefit from this experiment. Students should be prepared to take notes of their observations as the experiment progresses.
2. Prepare cloud chamber as directed on activity sheet.
3. Most of the tracks will be about 1/2 inch long and quite sharp. Explain that these are made by alpha radiation.
4. Sometimes you will see longer, thinner tracks. Tell students that these are made by beta radiation.
5. Occasionally, you may see some twisting, circling tracks that are so faint they are difficult to see. Tell students these are caused by gamma radiation.

Sample Discussion Questions:

1. You could not actually see the radiation. What kind of observation did you experience?
   (Indirect observation)
2. What is actually happening to the radioactive source?
   (The radioactive source is decaying.)
3. What radiation "footprints" did you see? Describe them.
   (Answers will vary. See descriptions on activity sheet.)

Teacher Evaluation of Learner Performance:

Learner notes of observations taken as the Cloud Chamber activities progress may be collected and used to determine degree of comprehension.

Learner response to questions/participation in discussion as the experiment progresses will indicate comprehension.

Enrichment:

Atoms and Isotope Review, p. SR-17, 109
Chemical Element Worktable, p. 117

Additional Enrichment:

The following are additional experiments that can be done with a Cloud Chamber:

Experiment A: How far can radiation travel?

Carefully mark the top of the jar at the point where the alpha tracks disappear. Measure how far the radiation travelled from the source. Then measure the beta tracks. Which type of radiation travelled farthest from the source?

Experiment B: Does a magnet affect radiation?

Hold the north end of a strong magnet next to the jar. Do you see any effect on the alpha tracks? On the beta?

Experiment C: How does shielding affect radiation?
Wrap the source in a sheet of paper. Which types of radiation are still visible?
Wrap the sample in a sheet of aluminum foil. Is the effect the same?
What happens if you use plastic wrap or cloth?
What types of radiation are stopped by each material?
(Be sure to allow time to cool the jar after each time it is opened.)

If you have access to a Geiger counter, students can test various items to see if they are radioactive. Materials that can be used include luminous clock dials from old clocks, “lite” salt (potassium chloride), some closionne jewelry, orange-glazed Fiestaware dishes, and smoke detectors. Students can also test the background radiation present in the classroom.

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INTRODUCTION

Radiation

Radiation is perhaps easiest to understand when you remember that it is energy moving through space in the form of waves and particles. Radiation is everywhere — in, around, and above the world we live in. We could think of it as a natural energy force that surrounds us. We are generally not very aware of it until we are reminded of it by someone or something, like a reflector on a bicycle, a full moon, or listening to a favorite radio program.

Types of Radiation

Depending on how much energy it has, radiation can be described as either *non-ionizing* (low energy) or *ionizing* (high energy).

Non-Ionizing Radiation

All our lives, perhaps without knowing it, we have reaped the benefits associated with non-ionizing radiation. For example, radio and television waves provide news and entertainment in the home, microwaves ease some cooking tasks, the light from electric light bulbs takes away the night, and the ultraviolet light from grow lights brings an artificial sun indoors for our flowering plants. These are some forms of non-ionizing radiation.

Ionizing Radiation

High-energy ionizing radiation is called ionizing because it can knock electrons out of atoms and molecules, creating electrically charged particles called *ions*. Material that ionizing radiation passes through absorbs energy from the radiation mainly through this process of *ionization*.

Ionizing radiation can be used for many beneficial purposes, but it also can cause serious, negative health effects. That is why it is one of the most thoroughly studied subjects in modern science. Most of our attention in this section will be focused on ionizing radiation — what is it, where it comes from, and some of its properties.